

Nano consortium hits stride in middle age

By Eddy Ball

In 2010, NIEHS took a bold step forward, by supporting the NIEHS Centers for Nanotechnology Health Implications Research (NCNHIR) Consortium, bringing together researchers, funded through several grant mechanisms, to accelerate understanding of the health implications and risks associated with engineered nanomaterials (ENMs). Now in its third year, the consortium's eight centers gathered once more at NIEHS Feb. 25-26 for an annual review of its progress toward that goal.

The meeting began with a welcome by NIEHS Deputy Director Rick Woychik, Ph.D., that included a cautionary assessment of the current understanding of ENMs, which have become ubiquitous in the environment. "The sobering thing is how little we know about the potential deleterious health effects of these materials," he said. "Fortunately, we've made some progress over the past few years..., but there's still a lot of work that needs to be done."

By the time the meeting came to a close, however, participants were talking optimistically about the potential insights that could come, as the enormous amounts of data generated by each of the centers' projects are collected in the [Chemical Effects in Biological Systems \(CEBS\)](#) database, housed at NIEHS. As NIEHS Program Manager Sri Nadadur, Ph.D., explained, "Once we have the data centralized in CEBS, it should be easy to identify the gaps [in our research]."

Looking across models

A major goal of the five-year NCNHIR consortium program, from the beginning, has been to build an integrated, strategic research program — ONE Nano — to increase fundamental understanding of how ENMs interact with living systems, develop predictive models for quantifying ENM exposure and assessing ENM health impacts, and guide the design of next-generation ENMs to minimize adverse health effects.

Using mice, rats, zebrafish, and human cell lines as models, multidisciplinary teams of scientists have tested the toxic effects of as many as 20 different ENMs and how the most common coatings impact the dissolution rate of ENMs in biological systems. Most of the research has focused on lung, the most common route of entry, but several projects have looked beyond the lung to the effects of ENMs on distant organs and the cardiovascular, digestive, and reproductive systems.

Along with their independent research projects, eight of the centers and consortium partners collect and share data about a common set of ENMs — four different silver nanoparticles, and multiwalled carbon nanotubes with several different aspect ratios. This work complements work on these same materials by NTP.

Along with exploring potential effects on distant organs, consortium researchers, such as [Martin Philbert, Ph.D.](#), (<http://www.sph.umich.edu/iscr/faculty/profile.cfm?unique=philbert>) of the University of Michigan, and [Harvey Clewell, Ph.D.](#), (<http://www.thehamner.org/scientists/entry/harvey-j-clewell-iii>) of the Hamner Institutes for Health Sciences, are asking new questions about ENMs. During a discussion on day two of the meeting, Philbert speculated about effects of ENMs in the extracellular space, and whether nanoparticles end up in cells or between cells. As Clewell said in his presentation, "We [also] have to consider the possibility of secondary



Nadadur opened the third annual meeting of the NCNHIR Consortium with an impressive catalogue of its accomplishments, midway through its five years of operation. His timeline showed that, with consortium data centralized in the CEBS database, the project is on track to meet its 2015 deadline for defining the scientific basis for risk characterization and risk assessment. (Photo courtesy of Steve McCaw)



During the meeting's poster session, University of Washington postdoctoral research fellow Ryan McMahan, Ph.D., left, described his team's research to North Carolina State University toxicologist James Bonner, Ph.D. (<http://projects.cals.ncsu.edu/toxicology/people/james-c-bonner/>) (Photo courtesy of Steve McCaw)



The poster session also gave consortium members an opportunity to talk about their accomplishments and future plans. Philbert, left, joined University of California, Los Angeles project director Andre Nel, M.D., Ph.D. (http://www1.cnsi.ucla.edu/institution/personnel?personnel_id=8739) (Photo courtesy of Steve McCaw)

mechanisms.”

The next step

“Part of CEBS is to make sure that all the nano data generated from NIEHS and NTP funding will be made accessible for any modeling efforts that anyone wants to carry out,” Nadadur explained. “Each of the centers has three projects — one to look at the interaction of ENMs and biological systems at the cellular level, one at the animal level — and both should interact. Then this data should be used by project three within the centers to see whether we can develop any models to predict hazards associated with exposure.”

Nadadur estimated that researchers should be able to submit their data by this summer. “All of this work has led to the generation of quality data, comparable across the centers, that is more valuable for modelers to use,” he said.

While the *in vitro* and *in vivo* studies involved hypothesis-driven research, the next phase of the consortium’s work will involve synthesis of data for novel meta-analysis. Its progress will be a topic of discussion at the next consortium meeting in September.



The program moved quickly as center project representatives presented their updates. Shown above, Imperial College researcher [Terry Tetley, Ph.D.](http://www1.imperial.ac.uk/medicine/people/t.tetley/), (<http://www1.imperial.ac.uk/medicine/people/t.tetley/>) center, answered questions as she handed over the podium to colleague [Kian Fan Chung, M.D., D.Sc.](http://www1.imperial.ac.uk/medicine/people/f.chung/) (<http://www1.imperial.ac.uk/medicine/people/f.chung/>) (Photo courtesy of Steve McCaw)



RTI International metabolomics center director Susan Summer, Ph.D., left, shared data with University of Michigan toxicologic pathologist [Ingrid Bergin, V.M.D.](http://ulam.med.umich.edu/academic/people/bergin.html) (<http://ulam.med.umich.edu/academic/people/bergin.html>) (Photo courtesy of Steve McCaw)



NIEHS Senior Toxicologist Chris Weis, Ph.D., was one of several scientists at the meeting representing Institute research divisions and, in Weis’ case, the Office of the Director. (Photo courtesy of Steve McCaw)



Former NIEHS Senior Science Advisor [Sally Tinkle, Ph.D.](#), (Former NIEHS Senior Science Advisor Sally Tinkle, Ph.D., enjoyed a place at the table by virtue of her role on the consortium's advisory committee. Tinkle currently serves as deputy director of the National Nanotechnology Coordination Office of the National Science and Technology Council.) enjoyed a place at the table by virtue of her role on the consortium's advisory committee. Tinkle currently serves as deputy director of the National Nanotechnology Coordination Office of the National Science and Technology Council. (Photo courtesy of Steve McCaw)



A veteran of NIEHS and NTP advisory boards, University of Washington toxicologist [Elaine Faustman, Ph.D.](#), (http://sph.washington.edu/faculty/fac_bio.asp?url_ID=Faustman_Elaine) went straight to the heart of the matter with her comments. "We know there's a lot of dosimetry data out there," she said. "It's just not in a form that we can easily access." (Photo courtesy of Steve McCaw)



NIEHS Outstanding New Environmental Scientist awardee [Jared Brown, Ph.D.](#), (http://www.ecu.edu/cs-dhs/pharmacology/Brown_May09.cfm) of East Carolina University, presented data on cellular uptake, clearance, and effects of carbon and silver ENMs in epithelial and endothelial cells. (Photo courtesy of Steve McCaw)



[Jennifer Foster, Ph.D.](#), (<http://alttox.org/ttrc/merging-technologies/-omics/way-forward/fofel/biography.html>) head of the CEBS team, waited patiently for her turn before the consortium's steering committee. The consortium is looking to centralization of its mass of data, to advance risk science for ENMs, using the combined capabilities of the consortium. (Photo courtesy of Steve McCaw)

Consortium milestones

In Nadadur's update on this ambitious project, he underscored the ways the consortium is shaping discourse about health effects of ENMs. The expansion of nano publications and the increasing visibility of nano research at major meetings are just a few examples of the consortium's influence.

- There have been 28 papers published — 18 of them in 2012, alone — with an additional 18 manuscripts under review and 12 more in preparation.
- Consortium research was highlighted at the 3rd U.S.-China Symposium on Nanobiology and Nanomedicine Dec. 4-7, 2012, in Beijing.
- Members participated in the ASME (founded as the American Society of Mechanical Engineers) 2nd Global Congress on NanoEngineering for Medicine and Biology Feb 4-6, in Boston.
- The Society of Toxicology annual meeting will have six symposium talks and 24 posters on consortium research.
- Consortium investigators (predictive modelers) will be invited to participate at an upcoming meeting of the National Nanotechnology Initiative on risk assessment.
- There are plans to showcase NCNHIR consortium efforts at NANOTOX 2014, the 7th International Nanotoxicology Congress in Turkey.

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